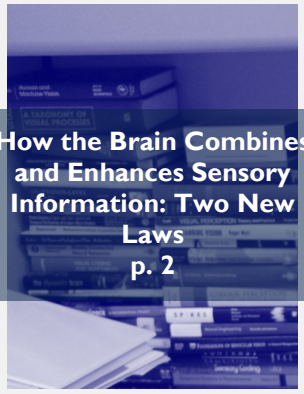
Summer 2019 | Vol. 8 Iss. 1

NAVAL MEDICAL RESEARCH UNIT DAYTON

Science Update



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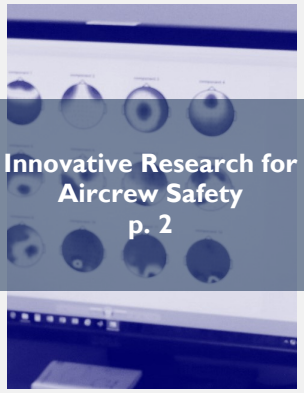

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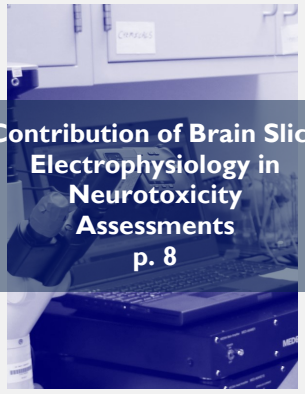

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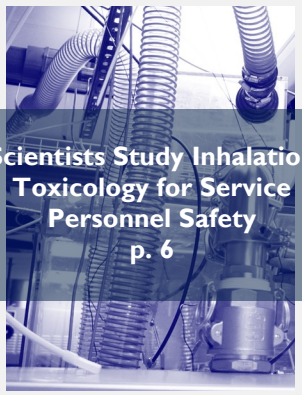

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Distribution A: Cleared for Public Release NAMRU-D-19-129

How the Brain Combines and Enhances Sensory Information: Two New Laws

By: Dr. Vince Billock, Senior Research Physiologist

Modern multisensory research is about 40 years old. Despite a tremendous research effort, multisensory interactions are not yet properly characterized. This situation contrasts strongly with other sensory phenomena, many of which follow well studied laws and are better understood. Lawful characterization is vital – it guides theory and vets experimentation; it tells you when to be surprised and when to be worried.

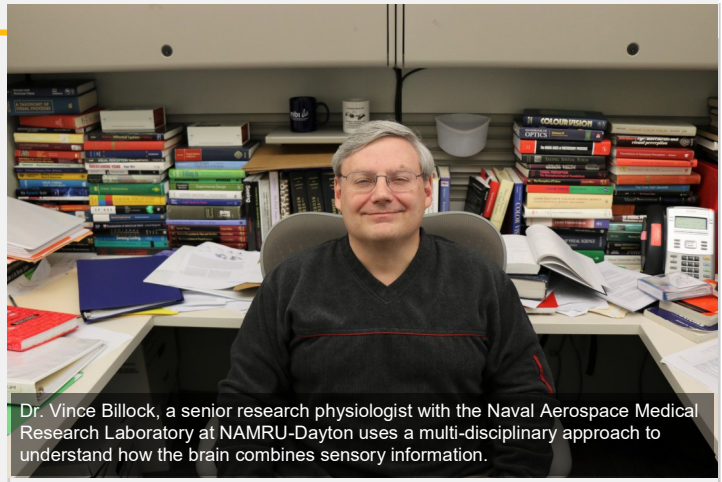
For several years I have been studying multisensory enhancement. For example a dim light looks brighter when a sound seems to come from the direction of the light. I've studied two kinds of multisensory enhancements: gated amplification and nonlinear combination. I found that gated amplification follows a power law (Billock & Havig, 2018).

$$AmplifiedResponse = a*UnamplifiedResponse^{n} \quad \textbf{Eq. 1}$$

Equation 1 says that to predict, for example, visual amplification by auditory stimulation, all we need to know is the unamplified visual response. The audio signal triggers the visual amplification, but the amplification does not depend on audio strength! This law holds for appearance judgements and it is followed by modulated unisensory cortical neurons. For both perception and neural spike rates, the fits to data are extraordinarily good (r2>0.99), and n is about 0.85. Similarly, a neural model of this amplification phenomena, which I developed for rattlesnakes (Billock & Tsou, 2014), has an exponent of 0.83. These slightly compressive exponents predict the most important property of sensory integration – weak signals are amplified more than strong signals.

A different rule governs perceptual sensitivity and bimodal cortical neurons. The law for combining two different sensory channels (A & B) is

$$CombinedResponse = (ChannelA^{m} + ChannelB^{m})^{1/m} \quad \textbf{Eq. 2}$$



Dr. Vince Billock, a senior research physiologist with the Naval Aerospace Medical Research Laboratory at NAMRU-Dayton uses a multi-disciplinary approach to understand how the brain combines sensory information.

In unisensory perceptual combinations (like binocular vision), *m* is usually between 1 and 8. Billock et al. (2019) compared perceptual sensitivity and neural sensitivity for audio-visual combinations using published data. Cat cortical bimodal cells (sensitive to both audio and visual) had a best fitting *m* value of 1.75. Remarkably, the best fit to comparable perceptual data had a quite similar *m* of 1.69.

We now know that both perceptual and neural multisensory enhancement follow just two simple laws (Eqs. 1 & 2). This means that we can now have some confidence in identifying the neural correlates of our perceptual experience. Efforts are underway to extend these results to visual interactions with tactile and vestibular stimuli. Visual-vestibular interactions are of particular importance to understanding spatial disorientations (see Williams, this issue).

Story Link

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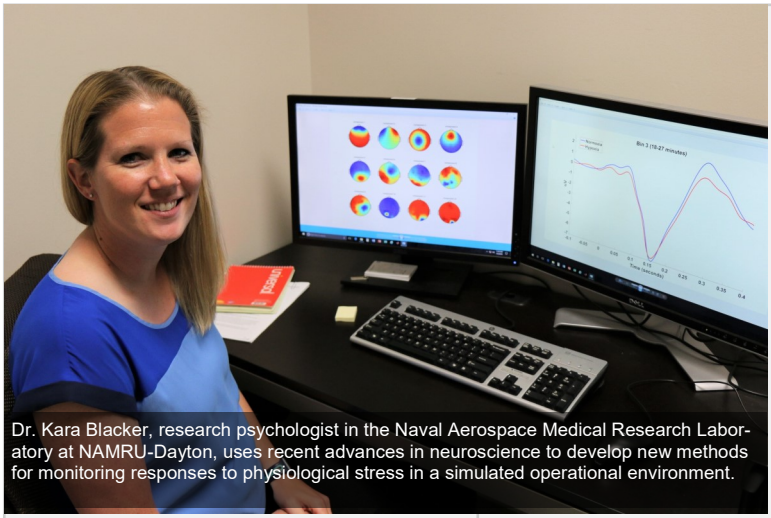
Innovative Research for Aircrew Safety



Dr. Kara Blacker, research psychologist in the Naval Aerospace Medical Research Laboratory at NAMRU-Dayton, uses recent advances in neuroscience to develop new methods for monitoring responses to physiological stress in a simulated operational environment.

By: Dr. Kara Blacker, Research Psychologist

The Naval Medical Research Unit Dayton's (NAMRU-Dayton) Naval Aerospace Medical Research Laboratory (NAMRL) continues to respond to the issue of physiological episodes with the goal of developing ways to keep aircrew safe. One line of research in these efforts is using electroencephalography (EEG) as a novel approach to detecting hypoxia, or low-oxygen condition. Hypoxia is known to adversely affect a range of sensory and cognitive functions, such as reaction time and memory. However, symptoms of hypoxia vary widely among different individuals and some individuals do not experience any identifiable symptoms at all. Therefore, a reliable method for detecting hypoxia and the impending negative effects on cognition is needed.

Dr. Kara Blacker, research psychologist, is testing the utility of EEG to detect hypoxia before symptoms occur. NAMRL's EEG Lab has a 64-channel Brain vision ActiCHamp EEG system that measures the electrical activity from the brain and can be used to assess sensory function. EEG is a non-invasive measure of brain activity that is recorded from electrodes placed on a person's scalp. In an ongoing series of studies, Dr. Blacker has found that an EEG signature, known as an event-related potential (ERP), is sensitive to hypoxia. By comparing the ERP response under normal conditions (i.e., normoxia) and a low-oxygen condition (i.e., hypoxia), the results show that the neural response is reduced under hypoxic conditions. Notably, this difference in the neural response occurred within the same timeframe that the participants began performing worse on a task under hypoxic conditions. These results suggest that EEG may be able to serve as an early detector of hypoxia.

Dr. Blacker and her team are currently working on refining this work to test whether ERPs can also serve to track recovery from a hypoxic exposure, which may inform return to duty practices. They are also developing methods to measure the ERP response faster and with less hardware, to make the process easier to use in an operational environment.

Story Link

Tackling Spatial Disorientation: A Deadly Threat to Aviation Safety

Dr. Henry Williams, senior research psychologist in the Naval Aerospace Medical Research Laboratory at NAMRU-Dayton, explains the unique capabilities in the spatial disorientation lab. Dr. Williams uses flight simulators to support pilot safety by specifically and systematically comparing how various types of workloads interfere with the maintenance of spatial orientation in simulated flight, potentially causing spatial disorientation.

By: Dr. Henry Williams, Senior Research Psychologist

Spatial disorientation (SD) refers to a pilot's misperception of the attitude, position, or motion of his/her aircraft with respect to the Earth's surface and/or gravitational vertical. The Navy Safety Center has cited SD as the number one contributing aeromedical factor in fatal aviation mishaps. When SD occurs, it typically does so in some form of degraded visual environment where the pilot lacks a clear view of the horizon, such as flight at night, in the clouds, or in blowing snow or sand. These are all conditions in which our military aviation personnel must operate. Without a visible horizon even the normal forces of flight can create powerful illusions that become extremely disorienting. If not recognized and resolved quickly, SD can lead to controlled flight into terrain, midair collision, entry into unusual attitudes, or inappropriate control inputs resulting in aircraft stall, loss of control, and/or structural failure. If SD leads to a mishap, it is usually a fatal mishap.

While several studies have examined the effects of SD on cognition or have linked increased cockpit workload to SD, few specifically and systematically compared how various types of workload interfere with maintenance of spatial orientation. Along with our Air Force and Army colleagues, Naval Medical Research Unit Dayton's (NAMRU-Dayton) Spatial Disorientation Lab is looking into this issue with support from the Defense Health Agency Research and Development Directorate and the JPC-5 Aviation Mishap Prevention Working Group .

In a recent study in our lab, 24 pilots flew simulated flights where they followed a lead aircraft first above, then into dense clouds. The lead aircraft then disappeared while in a turn, whereupon the subject was to recover to straight and level flight. Four different workload conditions were presented. The baseline condition included no additional workload, while the other conditions added either a verbal working memory task, a spatial mental rotation task, or a spatial variable-following-distance task. Measures of flight performance included the number of control reversal errors (CRE's), where the subject banked the aircraft in the wrong direction during recovery, and instances of unusual attitudes in the clouds. The results showed that the verbal working memory task condition led to a statistically significant threefold increase in the number of control reversal errors, while the mental rotation and variable-following-distance task conditions yielded significant increases in unusual attitudes.

This type of research helps scientists better understand SD because it shows that cockpit workload need not be spatial in nature in order to increase SD incidence, since it was the verbal task that led to the most CREs. This work also demonstrates the importance of using various measures of SD; the two spatial workload tasks would have appeared to have had no effect on pilot performance were it not for the unusual attitudes metric.

Decreasing the occurrence of SD is an ongoing challenge. Through research like this we can increase our knowledge about SD and the conditions that can cause it, and in turn better educate our aircrew on how to avoid and recover from this deadly threat.

Story Link

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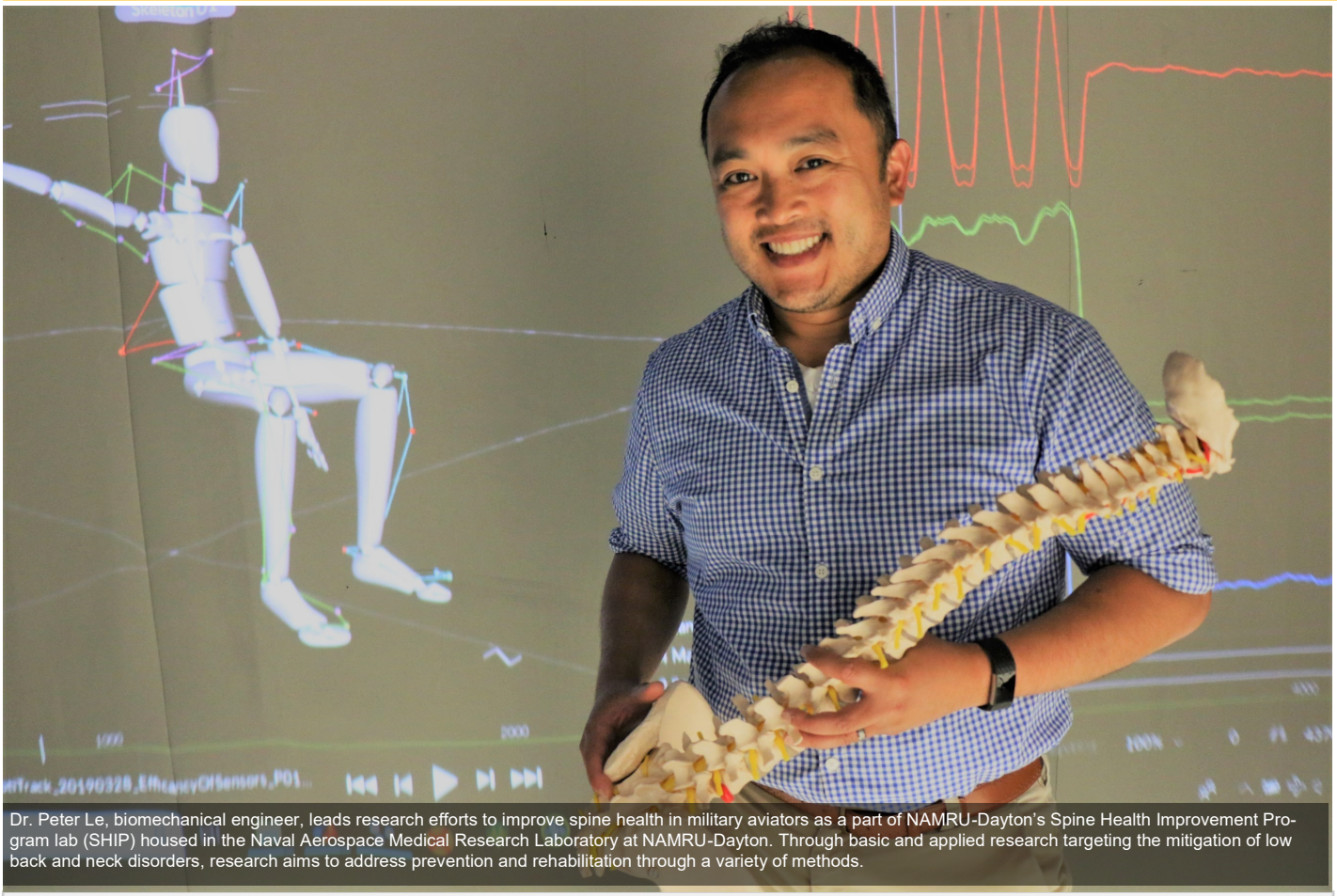
Research to Improve Spine Health among Aircrew



Dr. Peter Le, biomechanical engineer, leads research efforts to improve spine health in military aviators as a part of NAMRU-Dayton's Spine Health Improvement Program lab (SHIP) housed in the Naval Aerospace Medical Research Laboratory at NAMRU-Dayton. Through basic and applied research targeting the mitigation of low back and neck disorders, research aims to address prevention and rehabilitation through a variety of methods.

By: Dr. Peter Le, Biomechanical Engineer

The strenuous occupational demands endured by our military aircrew have resulted in a host of musculoskeletal disorders, with the highest reports related to low back pain (LBP) and neck pain (NP). These reports are associated with high medical costs, inability to fly, as well as reduced productivity and performance, thereby affecting operational readiness and effectiveness. Although a significant amount of research has attempted to reduce the risk of LBP/NP, the problem persists as causal pathways remain unclear. Survey data have provided knowledge on areas of concern (i.e., poor cockpit ergonomics, awkward postures, whole-body vibration, head-supported masses, etc.) and corrective interventions have been deployed as an immediate response, but many have failed because they have not targeted the underlying problem.

The Spine Health Improvement Program (SHIP) has several initiatives to understand and develop strategies to reduce LBP and NP among aircrew. These initiatives target causal mechanisms of injury, employ a 'systems-perspective' philosophy (interaction between physical loads, psychosocial/ organizational factors, and individual differences), while developing approaches to streamline measurements in the field and track return-to-duty status. Dr. Peter Le, biomedical engineer and program lead for SHIP, is leading the effort in response to the National Defense Authorization Act (NDAA FY17), Sec. 750, a request to study the health of rotary-wing and tilt-rotor pilots and Joint Concept for Health Services (2015), required capability #5: medical mitigation of the environment. SHIP targets both prevention and return-to-duty, through quantifiable, biomechanical/physiological measures. These include measures of movement, muscle activity, force production, fluctuations in heart rate, and changes in muscle oxygenation, while integrating task performance as a factor to understand the mind-body interaction. These data allow us to explore possible links between biomechanical changes and human performance. While these measures may provide insight between testing conditions, the key lies within the interpretation of the measures to explore the causal pathways of injury.

Current funded efforts target three areas: 1) causal pathways of LBP and NP during prolonged seating (i.e., visual stressors, individual differences/cognitive workload and biomechanical effects), 2) development of analytical methods to quantitatively measure biomechanical functional status in the field, and 3) evaluation/validation of fielded motion tracking analytics systems. In addition to the target areas, the laboratory capabilities are designed with the intent to enhance collaborations and support multiple research groups needing quantitative biomechanics/ ergonomics assessments. These currently include 1) assessments of industrial exoskeletons (USAF 711th HPW) and 2) movement differences from body-mounted sensors and equipment (Gallo and Warner).

Overall, the SHIP lab is developing capabilities to **assess** causal pathways for LBP/NP, **design** methods to assess those pathways, and **evaluate** currently fielded systems/interventions. In essence, the SHIP philosophy to reduce LBP and NP among our aircrew is to be **Intervention-Oriented, Mechanism-Driven**.

Story Link

Naval Research Internships Inspire Future Careers

By: NAMRU-Dayton Public Affairs

This summer, Naval Medical Research Unit Dayton (NAMRU-Dayton) welcomed a cohort of 13 students with science, technology, engineering, and math (STEM) backgrounds to intern at the command for a few weeks of scientific learning and exploration. The range of internship opportunities allowed students to shadow our staff in conventional scientific research fields as well as other STEM areas, including fabrication and engineering.

“The most surprising thing about NAMRU-Dayton was the amount of projects going on at once,” said Natalie Gut, an intern at the Environmental Health Effects Research Laboratory (EHEL). “Everyone seems to have a hand in multiple projects. Every day is different for me.”

Kasey Bernt, an intern for NAMRU-Dayton’s Naval Aerospace Medical Research Laboratory (NAMRL) agreed, stating, “With all of the projects going on, the research and learning environment here has been full of opportunity.”

Not only do these internships provide opportunities for students, but they also help our command continue to grow and innovate.

“These internships give NAMRU-Dayton access to young minds and current thinking which offers us a different perspective,” said Dr. Lynn Caldwell, senior research psychologist at NAMRL. “It gives young students the opportunity to see how research is conducted in a real lab setting, equipping them with valuable skills to prepare them for professional challenges.”

Along the way, each student had the guidance and support of a mentor invested in their personal and professional growth to face the challenges they experienced.

“Feeling like I can go to people and gain knowledge that I need not only for this job, but for furthering my own goals, has been a wonderful part of my time here,” said Megan Boltz, an intern for fatigue studies at NAMRL. “It’s great being part of a team.”

Indeed, NAMRU-Dayton offered interns the ability to make meaningful contributions to our science and make their mark as valuable team members.

“Our interns have been extremely helpful in getting our projects finished,” said Dr. F. Eric Robinson, research psychologist and mentor to two interns. ”They help us prepare for projects, collect and organize data, and help with purchasing and setting up equipment. We couldn’t have done the work we did this summer without their support.”

Often, the ability to make a difference is often what keeps our interns coming back to the command, as in the case of returning research intern, Ashton Hughes.

“I chose to come back to NAMRU-Dayton because of the mission,” says Hughes. ” For example, right now, I’m working on a project focused on warfighter safety during critical care air transport. I feel great knowing that what I do will help someone.”

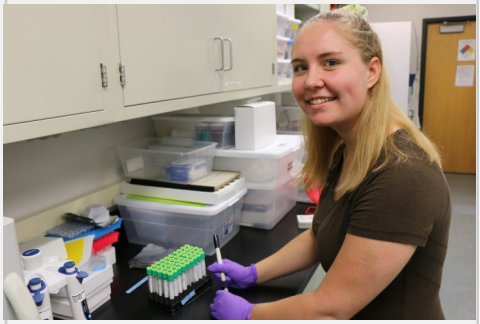
Tyler LaBance, a fabrication intern who also returned for a second summer with the command, shares the similar sentiments.

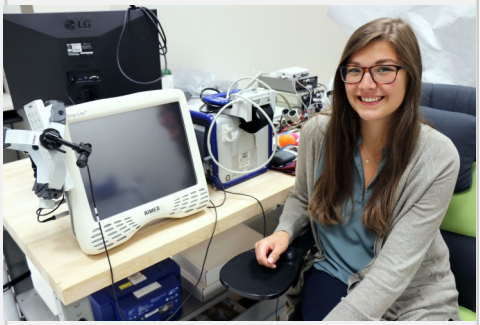
“I enjoy feeling good about my work, and I was definitely excited to come back,” said LaBance. “Where else can you work on something as unique as the Disorientation Research Device? Not only do we get to interface with interesting equipment, but we contribute to projects that help save lives.”

Though the internships last just a few weeks, the experiences they offer can provide the basis for an entire career.

“This internship was an amazing way to gain more insight into the scientific world,” said psychology intern, Marissa Tharp. “I feel more confident about pinpointing my research interest for when I pursue my masters degree.”

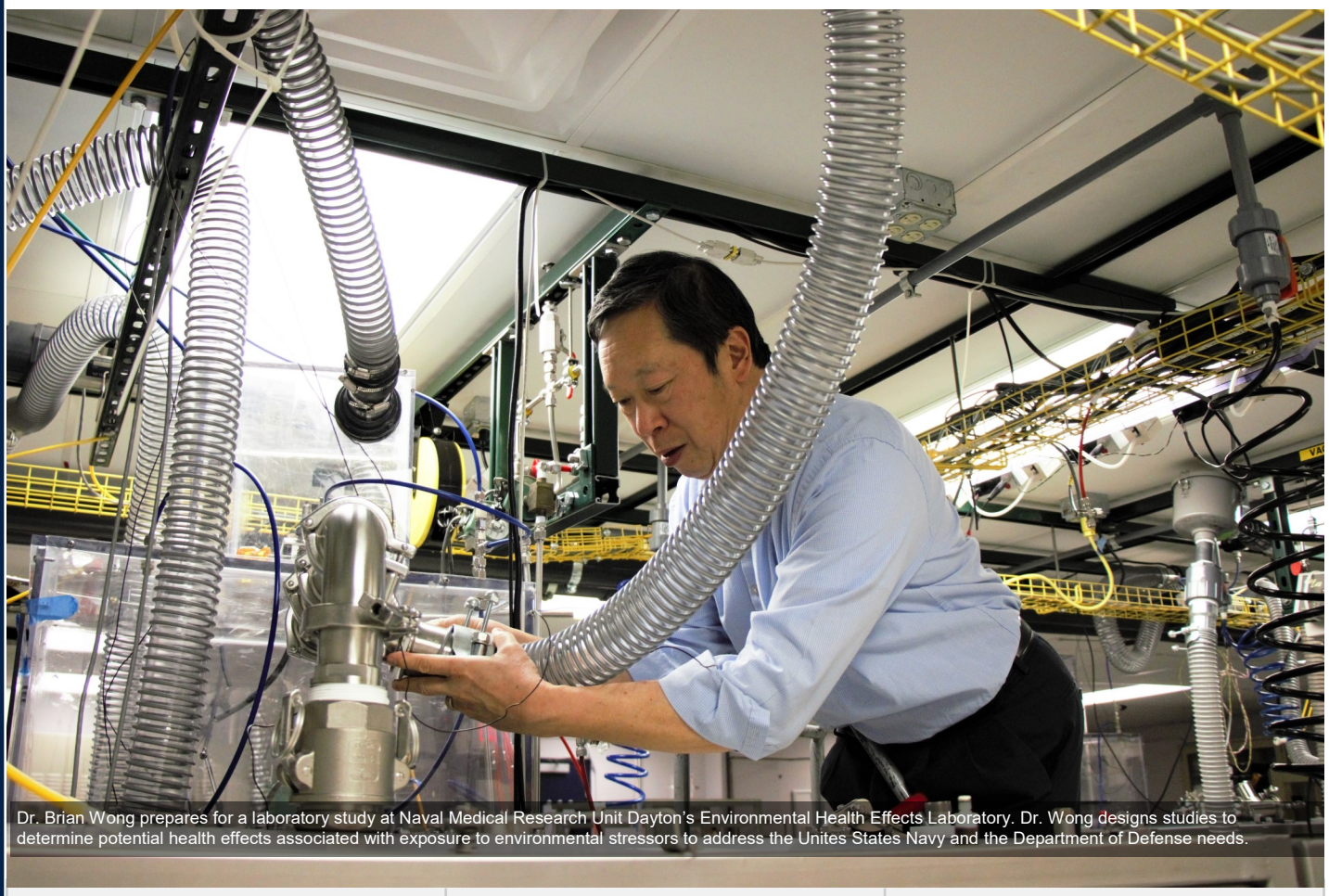
As the interns move on to pursue their educational goals, NAMRU-Dayton hopes to continue its commitment to fostering an environment which encourages the professional development of STEM students. The command looks forward to welcoming new cohorts in the years to come.





Story Link

Scientists Study Inhalation Toxicology for Service Personnel Safety



Dr. Brian Wong prepares for a laboratory study at Naval Medical Research Unit Dayton's Environmental Health Effects Laboratory. Dr. Wong designs studies to determine potential health effects associated with exposure to environmental stressors to address the Unites States Navy and the Department of Defense needs.

By: Dr. Brian Wong, Senior Inhalation Toxicologist

Since 2010 my mission has been to work with scientific experts and their research teams at the Naval Medical Research Unit Dayton's (NAMRU-Dayton) Environmental Health Effects Laboratory (EHEL) to design studies to determine potential health effects associated with exposure to environmental stressors, whether in the sea, on land, or in the air. Addressing the United States Navy and the Department of Defense needs, EHEL's goal is to enhance warfighter health, safety, performance and readiness through research.

The field of inhalation toxicology is the science of the biological effects of materials that can be inhaled by people. This field is truly multidisciplinary because it requires contributions from several areas of expertise. These areas can include chemistry, to understand the properties of the test material; engineering of all kinds, to put together systems to produce a test atmosphere under well-controlled conditions; whole animal biology and biochemistry, to evaluate the effects on the research subjects; the exposure effects on behavior, coordination, memory, or decision-making abilities; and finally translational expertise to be able to relate results to people.

EHEL research supports the Navy in addressing issues relevant to submariner health, specifically the potential risk to women in the non-ambient submarine atmosphere because components of the atmosphere had never been tested in the context of reproductive and developmental considerations. NAMRU-Dayton engineers and technicians built state-of-the-science systems to simulate the oxygen and carbon dioxide found aboard Navy submarines and collaborated with toxicologists and reproductive specialists to determine if there was a potential risk to females[1-5]. The Navy uses these studies to set safe exposure limits of carbon dioxide in the confines of a submarine[6,7]. Currently, emissions from 3D printing technology are being assessed for potential inhalation toxicity.

On land, jet airplane fuelers and servicers might be exposed to jet fuel mists as planes are refueled. The military is testing eco-friendly jet fuels and alternative methods to limit dependence on crude oil. To understand how these fuels compare in toxicity, EHEL collaborated with the United States Air Force Alternative Fuels Certification Office (AFCO; AFMC ASC/WNN), WPAFB OH to study if safe exposure limits need to be readjusted[8]. In response to service personnel returning from Southwest Asia experiencing respiratory issues, EHEL simulated dust storms and waste disposal burn pits[9] to determine if the exposure to dusty conditions, while in the vicinity of a solid waste open air burn pit, could explain these respiratory problems.

In the air, as an airplane climbs, air pressure decreases, as does the amount of oxygen available to a pilot. Planes are equipped with a system to increase the oxygen in the pilot's breathing air to ensure an adequate oxygen supply. However, measurements taken in the breathing air have detected some contaminants. The Navy and Air Force are intensely interested in ensuring these contaminants do not exceed a safe level for the pilot, and that the contaminants are not having an indirect side effect on pilot performance. The NAMRU-Dayton EHEL engineering group adapted some of our inhalation exposure systems to handle reduced pressure so we can take research subjects to a simulated altitude, expose them to test contaminants, and then be evaluated by EHEL behavioral scientists.

I am adapting my experience with inhalation studies with the expertise of EHEL researchers to look at effects on physiology and behavior to further ensure the safety and operational capabilities of our service personnel.

Story Link

Developing Novel Neuronal Models to Advance Neurological Function Research

By: Dr. Andrew Koesters, Neuroscientist

Military service members become exposed to a wide variety of hazardous substances that have the potential to produce adverse health effects. Naval Medical Research Unit Dayton's (NAMRU-Dayton) Environmental Health Effects Laboratory (EHEL) is charged with investigating health effects of environmental hazards and stressors to develop health protective exposure standards. Funded by the Navy In-House Laboratory Independent Research Program (ILIR), neuroscientist and principal investigator Dr. Andrew Koesters, is conducting a study to better understand neurological function post exposure.

Previous studies indicate exposure to lead may result in lead poisoning, which is multi-symptomatic in nature and known to be especially lethal to the nervous system. Firing ranges, both civilian and military, have been recognized as sites for possible lead exposure and toxicity, by inhalation of fumes and dust, ingestion via contaminated hands, or through contact with the skin that can have varying effects depending if the exposure is acute or chronic. Acute exposure commonly involves a rapid onset of nausea, headache, and/or cognitive impairment, while chronic, long-term exposure has a higher incidence of neurodegeneration and psychiatric disorders.

The nervous system relies on its ability to respond and adapt to changes in its activity levels, called 'synaptic plasticity'. Effective functioning of this process underlies normal neurological functions such as movement, thinking, learning and memory, and perception, and malfunctioning of this plasticity could trigger a variety of psychiatric, cognitive, and neurological disorders. There are several ways that the brain employs these plasticity mechanisms, which serve different functional purposes. One type of plasticity is thought to be responsible for learning and memory, and it has been established that lead can impair this process resulting in cognitive deficits. More recently, lead has also been linked to another type of plasticity, homeostatic plasticity, in the brain that is believed to stabilize neuronal function. Although it has been known that lead results in nervous system dysfunction and neurological impairments, it is still not known how.

Using these links between lead exposure and altered homeostatic plasticity within the brain, Dr. Koesters hopes this research will eventually result in new preventative or intervention countermeasures to lead poisoning and to develop new models that the military, academia, and industry can use to better investigate neurological function.

Dr. Andrew Koesters, neuroscientist, sits next to a biosafety cabinet to culture neurons in NAMRU-Dayton's Environmental Health Effects Laboratory, which is equipped to study a variety of hazardous environmental effects in an effort to develop health protective exposure standards for our military.

Story Link

References from p. 6 - Scientists Study Inhalation Toxicology for Service Personnel Safety

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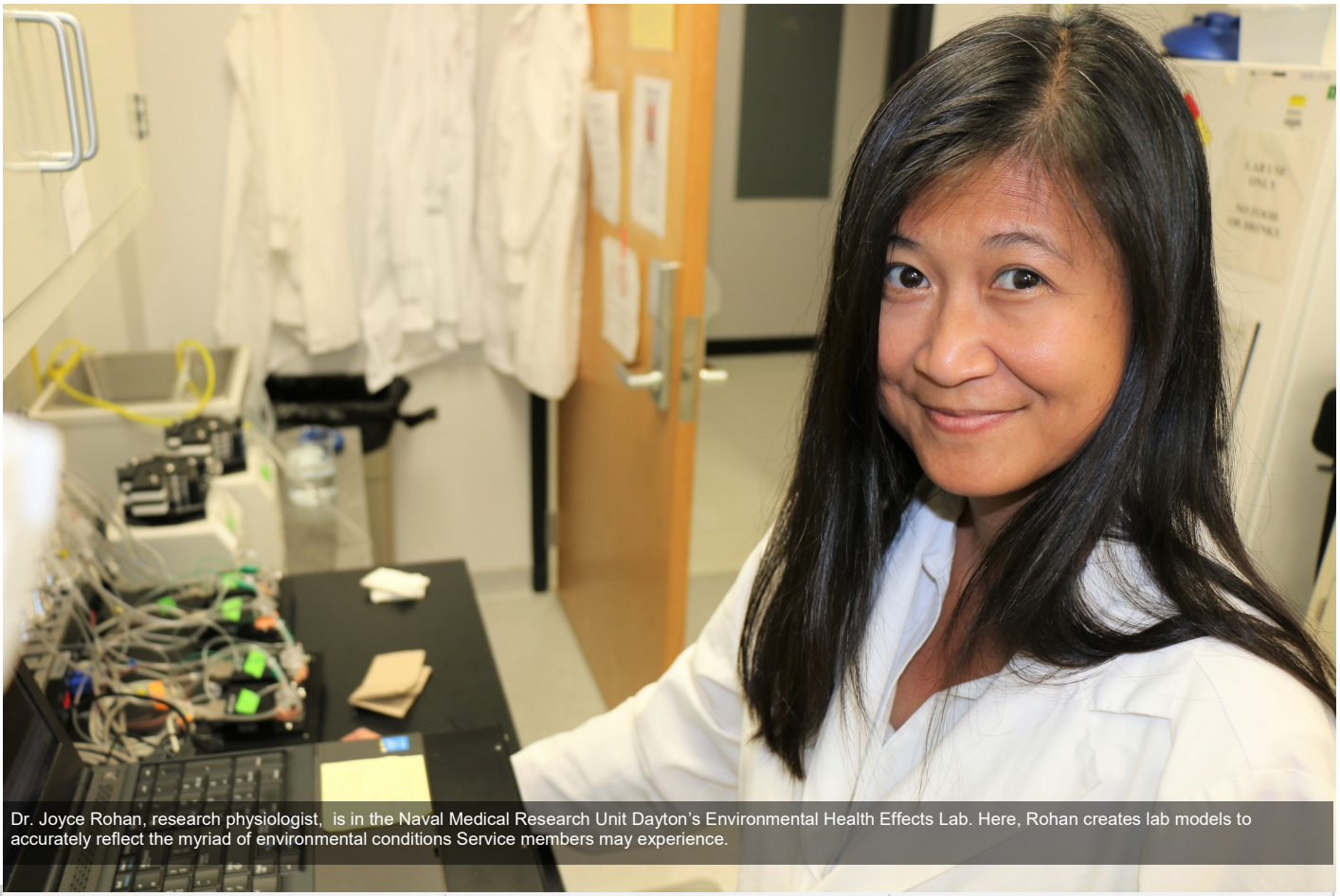
Contribution of Brain Slice Electrophysiology in Neurotoxicity Assessments



Dr. Joyce Rohan, research physiologist, is in the Naval Medical Research Unit Dayton's Environmental Health Effects Lab. Here, Rohan creates lab models to accurately reflect the myriad of environmental conditions Service members may experience.

By: Dr. Joyce Rohan, Research Physiologist

Detecting cognitive deficits in an animal model can be difficult because they communicate differently than humans. Behavioral assays that assess thinking in animals are complicated to perform, often requiring multiple days, making detection of immediate effects challenging. In addition, these cognitive tests typically cannot be performed on the same animals more than once and thus additional sets of animals are needed to evaluate effects at multiple time points after exposures. Electrophysiology offers an alternative approach for detecting cognitive effects by directly measuring the electrical activity of neurons that are essential for cognition.

At the Naval Medical Research Unit Dayton's (NAMRU-Dayton) Environmental Health Effects Laboratory, we have incorporated electrophysiology using brain slice in conjunction with biochemical measurements and behavioral testing for our neurotoxicity studies. We currently have five funded projects in which brain slice electrophysiology plays a prominent role in characterizing exposure effects on the central nervous system. Those projects involve exposures ranging from chemicals routinely used during the Gulf War to extreme temperatures. Most of our brain slice electrophysiology studies focus on the hippocampus, a region of the brain essential for cognitive processes such as learning and memory. The contribution of this electrophysiology is to aid in the detection of subtle changes in neuronal function within the hippocampus that can lead to cognitive impairments. Our microelectrode array system is capable of delivering electrical stimulations and thus can be used to evaluate not only spontaneous neuronal activity but also synaptic transmission (communication among neurons) and synaptic plasticity (the ability of neurons to change strength of their contribution), both of which are absolutely essential for cognitive processes.

Using brain slice electrophysiology, we have found that different chemicals induced distinct changes in neurons within the hippocampus. For example, exposure to chemicals commonly used during the Gulf War induced reduction in the synaptic transmission, an enhancement of paired pulse facilitation which is a measure of short -term synaptic plasticity, and a reduction in spontaneous activity. A separate study showed that exposures to aluminum chloride induced a reduction in long-term potentiation which is a measure of long-term synaptic plasticity, likely indicating an impairment in learning and memory. We are currently addressing the question of which electrophysiological parameters can be correlated with cognitive impairment. In addition, NAMRU-Dayton also has an in vivo electrophysiology system that enables the recording of neuronal activity in a live, freely moving animal so that we can record neuronal activities at multiple time points in the same animal. NAMRU-Dayton also has a patch clamp electrophysiology system that enables the recording of single neurons so that we can gather insight into the pathways that are triggered inside of cells as a result of exposure to chemicals or other stressors.

Together with our existing biochemical and animal behavioral capabilities, the addition of electrophysiology in our neurotoxicity toolbox has equipped us to better understand threats to Service members and therefore protect them against potential neurotoxic hazards.

Story Link

NAMRU-Dayton Presents Research Findings at Military Health System Research Symposium

By: Megan Mudersbach, Public Affairs Officer, NAMRU-Dayton

Naval Medical Research Unit Dayton scientists participated in the 2019 Military Health System Research Symposium (MHSRS) in Kissimmee, Florida, August 19 -22. More than 30 scientists and science support staff from the command attended the annual meeting.

This year's theme, "Research for Readiness", focused on four primary areas: warfighter medical readiness, expeditionary medicine, warfighter performance, and return to duty. NAMRU-Dayton scientists presented research findings and discussed ongoing and future potential for collaboration with fellow innovators. All of which is in support of the unique medical research needs of our military.

"At MHSRS NAMRU-Dayton science experts connect with other experts to share knowledge and bridge data gaps so that we successfully conduct research for readiness," said Captain Matthew Hebert, commanding officer, NAMRU-Dayton.

NAMRU-Dayton's Environmental Health Effects Laboratory (EHEL) and Naval Aerospace Medical Research Laboratory (NAMRL) scientists presented research geared to uphold a ready force. Topics included exposure effects on performance, laser eye protection, Critical Care Air Transport team coordination, spatial disorientation, and fatigue mitigation.

Story Link

Environmental Health Effects Laboratory

Subject Matter Expert	Areas of Expertise
Richard Agans, Ph.D.* *Research Molecular Biologist*	Molecular Biology; Microbiology; Microbiome
Frank Golich, Ph.D.* *Chemist*	Aerospace Physiology; Physiological responses to operational environmental exposures; Biochemistry
Lt. Maria Greenwood, MSC, USN *Research Psychologist*	Neuroscience; Pharmacology; Toxicology
Col. Cary Honnold, DVM, Diplomate ACVP, ACVPM *Veterinary Pathologist*	Comparative pathology and consultation; Veterinary Anatomic Pathology; Veterinary Preventive Medicine
Rachel Howes, Au.D., CNIM* *Audiologist*	Neurophysiologic intraoperative monitoring; Electroneurodiagnostic Technology; Hearing thresholds; Hearing loss
Arden James* *Equipment Engineer*	Inhalation systems design; Construction and automation
Andrew Keebaugh, Ph.D,* *Environmental Toxicologist*	Environmental Toxicology
Andrew Koesters, Ph.D.* *Neuroscientist*	Electrophysiology; Molecular and Cellular biology; Cell and Tissue Culture; Synaptic Physiology
Lt. Cmdr. Taj King, MSC, USN *Biochemist*	Inhalation toxicology; Molecular and Cellular biology; Biochemistry
Sanjeev Mathur, M.D.* *Imaging Scientist*	Animal imaging; Animal surgeries
Chandrani Mukherjee, Ph.D.* *Chemist*	Organic chemistry; Biochemistry
Karen Mumy, Ph.D. *Director*	Toxicology; Chemical exposure; Health effects of exposure; Environmental exposures; Microbiology; Cellular biology; Inflammation; Microbiome
Joyce Rohan, Ph.D. *Research Physiologist*	Neuroelectrophysiology; Ion channel physiology; Neurotransmitter release mechanisms; Synapse physiology
Shannon Romer, Ph.D.* *Neuroscientist*	Neuroscience; Neurobiology and neurophysiology; Immunohistochemistry; Respiratory plasticity
Lt. Cmdr. Nicholas Schaal, MSC, USN *Industrial Hygiene Officer*	Chemical Induced Hearing Loss; Hearing conservation; Hazardous noise exposure characterization; Occupational exposure assessment; Industrial Hygiene
Lt. Cmdr. Matthew Shipman, MSC, USN *Aerospace Physiologist*	Microbiome; Systems biology; Physiological response to operational and environmental exposures; Hypoxia/Decompression illness
Cmdr. Jason SchmittSchmitt, MSC, USN *Deputy Director*	Biochemistry
Satheesh Sivasubramani, Ph.D.* *Inhalation Toxicologist*	Inhalation Toxicology; Aerosol Technology
John Stabley, Ph.D.* *Physiologist*	Integrative Physiology; Bone and Vascular Physiology; Molecular and Cell Biology
Brian Wong, Ph.D.* *Inhalation Toxicologist*	Inhalation toxicology and technology; Aerosol Technology; Atmospheric Chemistry
David Wu, Ph.D.* *Cell Physiologist*	Pulmonary morphometry; Cellular biology; Physiology; Ion channel physiology; Inflammation; Immunology
Jason (Zhong Xin) Wu, Ph.D* *Physiologist*	Cardiorespiratory Physiology; Pharmacology; Environmental Toxicology; Neurophysiology
LT Dan Xu, MSC, USN *Biochemist*	Stem cell biology; Toxicology

*Indicates government contractor +Indicates Intergovernmental Participant Appointment

Naval Aerospace Medical Research Laboratory

Subject Matter Expert	Areas of Expertise
Richard Arnold, Ph.D. *Director*	Aviation Psychology; Test and Scale Construction; Personnel Selection Testing; Differential Psychology
Eric Bandstra, Ph.D.* *Senior Biomedical Engineer*	Biomedical Engineering; Biomedical device human testing
Vincent Billock, Ph.D.* *Senior Research Scientist*	Sensory Biophysics; Sensory Integration; Vision Sciences
Kara Blacker, Ph.D.* *Research Psychologist*	Cognitive Neuroscience; Cognitive training
J. Lynn Caldwell, Ph.D. *Research Psychologist*	Fatigue Assessment; Circadian disruption; Fatigue countermeasures
Lisa Damato, Ph.D.+ *Senior Research Physiologist*	Neuroscience; Electroencephalography
Michael Decker, Ph.D.+ *Neuroscientist*	Respiratory Physiology; Neuroscience; Neuroimaging
Dana DiPasquale, Ph.D. Senior Research Physiologist	Exercise physiology; Environmental physiology (thermal, altitude/hypoxia, hyperbaria, spaceflight, acceleration); Skeletal muscle biology, NIRS, altitude sickness; Applied and basic biological science
Lt. Cmdr. Matthew Doubrava, MC, USN *Flight Surgeon*	Occupational/Environmental Medicine; Aerospace Medicine; Public Health
Leslie Drummond, Ph.D.* *Research Psychologist*	Cognition; Visual Attention; Hypoxia Countermeasures
Capt. Rich Folga, MSC, USN *Aerospace Physiologist*	Disorientation Research Device: Kraken™; Spatial Disorientation
Matthew Funke, Ph.D. *Research Psychologist*	Cognitive Psychology; Workload & Stress Assessment; Non-Invasive Cerebral Monitoring
Megan Gallo, MS *Research Physiologist*	High-G Acceleration; Hypoxia Countermeasures; Thermal Stress
Lt. Cmdr. Cheryl Griswold, MSC, USN *Aerospace Physiologist*	Dehydration; Bladder relief; Physiologic Episode response
Lt. Cmdr. Micah Kinney, MSC, USN *Aerospace Optometrist*	Aerospace Optometrist; Vision Science
Peter Le, Ph.D. *Biomedical Engineer*	Biomechanics; Human Factors & Ergonomics; Low Back & Neck Pain
Daniel McHail, Ph.D. *Research Psychologist*	Neuroscience; Electrophysiology; Learning & Memory
Daniel Merfeld, Ph.D.+ *Senior Vestibular Scientist*	Vestibular Sciences
Emily Mills, Ph.D.* *Biomedical Engineer*	Biomechanics; Gait Analysis; Orthopaedic Preclinical Models; Viscoelastic Tissue
Cmdr. Tatana Olson, MSC, USN *Aerospace Experimental Psychologist*	Industrial & Organizational Psychology; Aviation Psychology & Personnel Assessment & Selection
Kyle Pettijohn, Ph.D.* *Research Psychologist*	Cognitive Psychology
Jeffrey Phillips, Ph.D.+ *Research Psychologist*	Aviation Psychology & Physiology; Hypoxia Mitigation; Human Performance
Michael Reddix, Ph.D. *Senior Research Psychologist*	Cognitive Psychophysiology; Visual Psychophysics; Directed Energy Bioeffects
Eric Robinson, Ph.D. *Research Psychologist*	Human Factors Psychology; Human Performance; Team Performance
Valarie Schroeder, Ph.D.+ *Cognitive Psychologist*	Cognitive Psychology
Mariateresa Sestito, Ph.D.* *Research Psychologist*	Neuroscience; Psychophysiology; Clinical Neuropsychology
Lt. Sarah Sherwood, MSC, USN *Aerospace Experimental Psychologist*	Human Factors; Human Systems Integration; Aviation Psychology
Barbara Shykoff, Ph.D.* *Senior Research Engineer*	Applied respiratory physiology; Cardiovascular & exercise effects
Dan Warkander, Ph.D.* *Senior Research Engineer*	Respiratory Equipment: Physiological Effects, Performance, Work of Breathing
Stephanie Warner, MS *Biomedical Engineer*	Hypoxia Mitigation; Imaging and Sensing Technologies; Biomedical Equipment Design/ Validation
Henry Williams, Ph.D. *Research Psychologist*	Aviation Spatial Disorientation

*Indicates government contractor +Indicates Intergovernmental Participant Appointment

NAVAL MEDICAL RESEARCH UNIT DAYTON

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This newsletter is a publication of the Naval Medical Research Unit Dayton
and is published biannually by the Public Affairs office.

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Distribution A: Cleared for Public Release NAMRU-D-19-129